

1. On the Diseases of the Carnivorous Mammals in the Society's Gardens. By J. B. SUTTON, Lecturer on Comparative Anatomy, Middlesex Hospital Medical College.

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Introduction.

In this paper it is proposed to give an account, as briefly as is consistent with accuracy and clearness, of some of the more important diseases which affect the Carnivorous Mammals, prisoners in the Society's Gardens.

So far as disease is concerned, there is no need to draw particular distinction between the various groups of this great class of animals. It is sufficient for my purpose to know the kind of food and general habits of any particular animal; consequently, in this paper, the refinements of zoological classification will be set aside, and the word "carnivorous" will be used in the broadest acceptation of that term.

The splendid and varied collection of flesh-eating animals, the property of this Society, offered me a rich hunting-ground for pathological spoil, and rich has been the ingathering.

From the outset of my *post-mortem* experience among these animals, my attention has always been aroused by two very opposite conditions of things:—one is the paucity, and in some cases, the total absence, of lesions to account for death; in the other case, one is struck with the existence of extensive disease of vital organs, which must have been present for a considerable period without destroying life.

For example, a Tiger is reported to be ailing, and in a few days the creature is dead. At the autopsy nothing to account satisfactorily for the animal's death can be discerned even after the most diligent search. Whereas an Esquimaux Dog which had been on the sick list for some time before its death, presented the following list of pathological conditions:—Ulceration of the left fore leg, probably cancerous; old valvular disease of the left side of the heart; atheroma of the aortic arch; three old infarctions in the liver, with three large cysts in the same organ. In addition to these lesions of important viscera, it had an enlarged prostate, an abscess in each testicle, carious teeth (a very rare condition in wild animals), psorosperms by thousands scattered through the voluntary muscles and lungs, and a venous nævus of the skin.

Of course it is within the bounds of probability that, in some of these cases where the animals die with only a few days of previous illness, they have been seized with some acute malady, which up to the present has eluded my search. Another fact of great importance in connexion with this observation should be mentioned. It is the great tendency of animals to die in pairs: for example, a Bear died; three days after its companion was found dead: no obvious lesion beyond evidence of inflammation of the alimentary canal in

one of them. Two Hyænas succumbed in a similar manner. Two Black-faced Kangaroos died within forty-eight hours of each other. Two Foxes were brought to the dissecting room within twenty-four hours; and of this sort of thing many instances among smaller mammals might be given, so as to carry it out of the domain of coincidence.

For some considerable time the suspicion of the existence of some acute specific disease contagious in its nature has held possession of my mind. More than once a singular feeling of languor and uncontrollable depression, accompanied with weariness, has seized me after conducting the necessary dissection on the animals dying after this manner, so that of late I have been more cautious than heretofore.

Let me now pass on to consider the various diseases in detail; they will be treated in the following order:—

1st, Those affecting the skeleton; 2nd, Diseases of the Organs of Respiration; 3rd, Affections of the Circulatory System; 4th, Diseases of the Alimentary Canal and the Viscera appertaining thereto; 5th, the Genito-urinary Organs; 6th, Tuberculosis, which, for various reasons to be explained later on, has been made a separate segment, instead of treating it along with diseases of the respiratory organs.

Diseases affecting the Skeleton.

1. *Rickets*.—This disease has been encountered many times, but its ravages are most severely seen among the smaller Carnivora. The affection is met with in two very distinct forms—"rickets of infancy" and "late rickets" occurring at puberty.

a. *Rickets of Infancy*.—The chief symptoms are deformity of the long bones and paralysis of the hinder limbs (paraplegia). Death usually results from some intercurrent malady, generally bronchitis, which is a very dangerous complication of rickets, on account of the softened ribs yielding to atmospheric pressure, ending in collapse of the lungs.

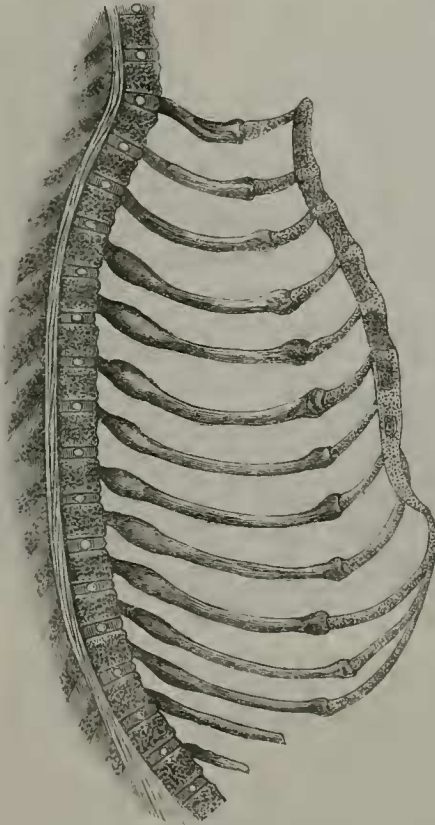
In this form of the disease, the skeleton is affected throughout. The thorax is deformed, there is beading of the ribs at their junction with the costal cartilages, and a second row of beads immediately external to the angles of the ribs: these are caused by partial fracture (infractions) of the softened ribs, and the abundant formation of provisional callus at the seat of injury. This is a very constant feature of the disease in Carnivora, but it may be confined to one side. This double row of rickety beads is shown in the drawing (fig. 1, p. 179). The skull is thin, soft, and in some places absorbed. The teeth are normal in size, number, and development.

The long bones of the limbs are curved, enlarged, and so soft that they may be cut with a knife easily. The periosteum is usually thicker than normal. The line of the epiphysial cartilage to the naked eye presents enlargement, irregularity, and abundance of the curious translucent gelatinous substance known as spongioid tissue, so eminently characteristic of rickets. Submitted to the scrutiny of the microscope, the following changes may be observed:—

(1) A layer of normal hyaline cartilage, which in health should not exceed a millimetre in thickness, but here it may measure as many as six, eight, or even twelve millimetres.

(2) A regular series of columns formed of superimposed cartilage-cells, which in health should consist of ten or twelve cells to the column, each column being separated from its fellow by a spicule of calcareous matter, all arranged as regularly as a phalanx of soldiers. But in rickets as many as fifty cells may be counted in each row,

Fig. 1.



The left half of the thorax of a Binturong (*Arctictis binturong*), severely affected with rickets. It shows the usual beading at the junctions of the ribs and costal cartilages, and a second row of beading just below the angles of the ribs, due to partial fracture and the subsequent formation of provisional callus.

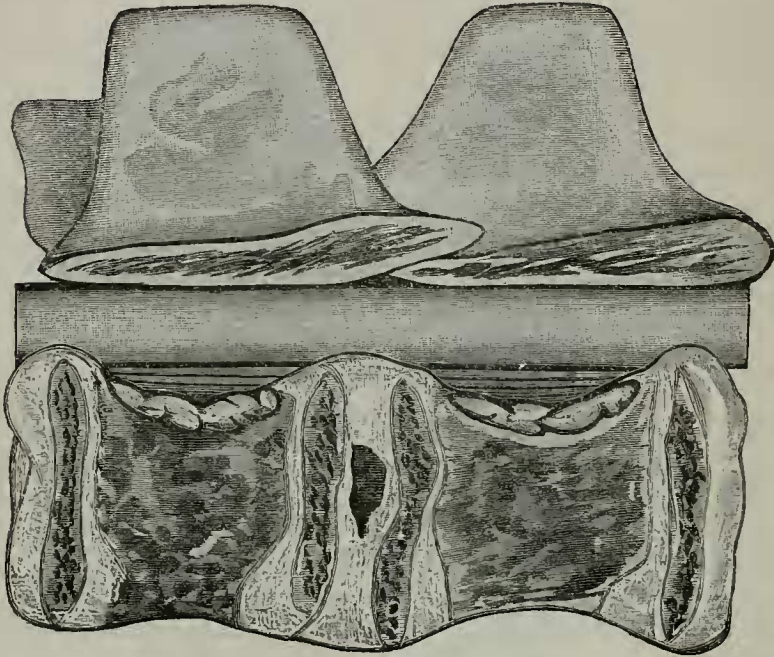
arranged in a disorderly manner, the confusion of disease contrasting remarkably with the definite order observable in the healthy epiphyses.

(3) Beyond these, a layer of irregular calcareous trabeculae enclosing here and there "islets" of spongioid tissue and hyaline cartilage.

This form of the disease is most frequent among the smaller mammals, *e. g.* those of the genera *Canis*, *Cynictis*, *Ichneumon*, &c.

b. *Late Rickets* (Rickets occurring at puberty).—At the age of puberty the disease presents certain peculiar features. In the first place it does not tend to generalize itself as in the form just considered, for it may attack the axial skeleton only, and in some cases affects the skull alone. The deformity is not so marked as in rickets of infancy.

Fig. 2.



A longitudinal section through the last dorsal and first lumbar vertebra of a Lion affected with "late rickets." It shows the proliferation of the tissue in the neighbourhood of the epiphysial plate, and the abnormal size of the intervertebral disk, bulging into the neural canal and compressing the spinal cord.

Its chief features are as follows:—Beading at the costal junctions is fairly constant. If the epiphysial cartilages are affected, the spongioid tissue is wanting, and a small quantity of fibrous tissue develops in its place; the line of the epiphysis is irregular. On this I place considerable importance as a sign of disease.

If the epiphysial plates of the vertebræ become affected, and this they are very prone to do, the proliferation may give rise to pressure on the spinal cord, and subsequent paraplegia as shown in the drawing (fig. 2), taken from a nearly full-grown Lion affected with this form of the disease.

Hypertrophy of the skull-vault is very common; it may exceed the usual thickness five or six times, the base of the cranium remaining unaffected. The teeth are large, defective in number, and

late in appearance. Death is usually brought about after this manner. The animal suffers from paralysis of the hind quarters, which gradually ends in paraplegia to such an extent that it is absolutely necessary to kill it. The paraplegia is brought about, as I have explained above, by pressure on the cord due to proliferation of the epiphysial structures, and this is the most important feature of the disease. For the vertebral plates at this age are, of all parts of the skeleton, the seat of the most active growth, just as in infancy the epiphyses of the long bones are undergoing extensive and rapid metamorphosis. The cord, when examined microscopically at the seat of compression, shows an increased quantity of neuroglia, a diminished number of axis-cylinders, fatty granules in abundance, and destruction of the nerve-cells in the grey matter.

2. *Mollities Ossium*.—This singular affection is met with in thoroughly adult carnivorous animals; it is a rare affection. My best and most characteristic case was from the Racoon-like Dog (*Nyctereutes procyonides*).

The chief features of the disease are these:—Beading of the ribs is wanting; softness of the bones is replaced by hardness and brittleness, so that they break easily; deformity of the long bones may be present to an extreme degree; the alveolar margins of the jaws absorb, allowing the teeth to fall out. When the bones are macerated and dried, they become as light as cork.

Paraplegia is a constant feature of the disease.

Summarizing these three forms of bone-disease arising from constitutional causes, however varied their manifestations, the ætiology is the same, viz. loss of exercise and active life, artificial mode of feeding compared with their wild state of living, and the vicissitudes of an English climate. Indeed, if referring to the human subject, it would be expressed in one terse sentence, “Bad hygienic conditions incident to the life of a captive.”

There can be no doubt that the different effects of the disease on the system are due simply to the fact that, at these different epochs of life, physiological processes taking place in a growing bone differ very materially, and as disease is to be regarded as a perversion or exaggeration of normal physiological processes, so we have an example of an alteration of the normal processes which should be in operation during infancy producing “rickets,” at puberty “late rickets,” and in adult life, when there are no epiphyses for the disease to attack, but “osteoporosis” is in full vigour, perversion leads to “mollities ossium.”

There seem to be two rules regarding pathological manifestations.

(a) Acute diseases attack those parts where the blood supply is greatest, and as a consequence growth is rapid.

(b) Functionless organs are prone to undergo degeneration or to become the seat of cancer, &c. Respecting the first rule:—In infancy the long bones are the seat of very active changes, particularly at the epiphyses; hence they become affected with rickets. At puberty, the vertebræ are developing their secondary centres, so they

are prone to become the seat of disease ; hence the so-called predilection of disease to attack particular structures. Examples of rule *b* will be given in treating of diseases of the ovaries.

Diseases of the Organs of Respiration.

Diseases of the lungs, in some form or other, make fearful havoc among these creatures, the three most common affections being Bronchitis, Pneumonia, and Pleurisy.

Bronchitis.—This condition of lung is most frequent among Lions, Tigers, and Leopards. It is very unsatisfactory to say that a beast died of this affection unless one has seen the creature during life ; but with the bronchi containing much frothy mucus and no other visible lesion, it is always with much reluctance I assent to have this word written in the death column. In rickety animals there is no need for doubt, as with soft, yielding thoracic parietes, even a slight attack of bronchitis in young animals is very quickly fatal.

Pneumonia (Lobar).—This is frequently met with among Carnivora ; it runs through the usual stages as observed in man—engorgement, red and grey hepatization. From my observations it would appear that death in the engorgement stage is of more common occurrence than in man. Bears are particularly subject to pneumonia, and in them the inflammatory products, instead of resolving, break down into pus. The posterior lobe of one lung is affected, but the morbid material in its course along the bronchi, and into the trachea, is drawn into the opposite lung by inspiration, so that the portion of lung immediately in the neighbourhood of the larger bronchi of the unaffected lung becomes affected, secondarily, by the morbid material thus inspired.

Pleurisy.—Double pleurisy is exceedingly common among the wild Carnivora, as it is in the domestic Cat (I exclude from this list those cases of pleurisy arising from inflammation set up by the presence of parasites in the lungs). The disease is usually double, and of long standing ; the fluid breaks down the barrier between the two pleural cavities, so that they form by means of organized inflammatory material one continuous cavity. The lung-substance becomes condensed and carnified by the pressure of fluid, which often amounts to two gallons ; this interferes with respiration, and the animal dies. This has caused the Society the loss of several very fine animals. The condition of the lung in collapse is so very interesting that it will be well to give a few details respecting it.

Condensation, Atelectasis, or Apneumotosis are terms used to signify the condition of the lungs before birth, or in other words lung-tissue which has never contained air. After respiration has been established, if from any cause the lung be rendered airless, as by the pressure of a tumour or particularly of fluid in the pleura, a return to the foetal condition is brought about. A lung which is thus collapsed is often referred to as being in “a state of carnification,” on account of the fleshy appearance it presents on section ; this alone is sufficient to distinguish it from pneumonic lung, notwithstanding that it sinks in water.

If sections of a lung, which has been compressed by fluid in the pleura for some considerable time, say six weeks, be examined by the microscope, the following appearances will be noted :—

The pleural covering is very thick, its surface being coated over by a thick layer of organized lymph varying in thickness according to the length of time the disease has existed. From the deeper layers of the pleura there is an invasion of fibrous tissue into the lung-substance, destroying the air-cells immediately subjacent to the original serous covering.

Beneath these disorganized air-cells, a considerable tract of airless tissue exists in which the cell-walls are in apposition, and lie folded together as neatly as a lady's fan. These cells, if inflated during life, would again become functional.

Approaching the main bronchus, curious changes may be seen ; here and there whole tracts of the lung-tissue are in a state of complete disorganization, others are seen with their opposite walls simply in contact, whereas in many parts the air-cells are so dilated that they present all the characters of emphysematous lung, so extreme is the distension of the air-vesicles and so attenuated their walls. Although the lung is apparently in a condition of extreme atelectasis, yet in parts, paradoxical as it may seem, we have to do also with a condition of emphysema and dilated bronchi.

The Organs of Circulation.

Few and far between are cases of diseases of the heart and blood-vessels in carnivorous animals. Once only have I seen pericarditis, and that was in a Coati. The disease was caused by the extension of inflammation from old-standing double pleurisy.

Valvular disease was seen in an Esquimaux Dog aged at least twelve years. The endocardium was thickened and opaque, the mitral and aortic valves presented vegetations on their free borders, some of which had evidently been detached by the circulating current, as three old infarctions in the liver bore indisputable testimony. Atheroma was encountered twice, once in the aortic arch of a Dog ; the remaining instance occurred in a Coati, in which the whole of the descending aorta was affected, some of the patches being of considerable size.

The Alimentary Canal.

Affections of the digestive tract are uncommon. Typhoid ulceration of the ilium and colon has been twice noted in the course of my dissections. The symptoms during life were such as to lead one to suspect the nature of the malady, diarrhœa and hæmorrhage from the bowel with similar cases turning up among other animals. The two cases mentioned occurred in a Tiger and a Leopard, about the same time as the cases referred to in my paper on Diseases of Monkeys.

Several Bears have died from enteritis, and in one a perirectal abscess attained to a considerable size, then burst into the peritoneal cavity, giving rise to intense and fatal inflammation. The abscess was in all probability caused by a piece of bone passing through the

wall of the rectum, and, getting into the cellular tissue, acting as a foreign body. I have known a fish-bone accidentally swallowed do the same thing in man.

Dogs are liable to intus-susception of the intestine, caused by swallowing tendons and other similar substances.

Genito-Urinary Organs.

The following injuries and diseases have been met with :—

Fracture of the os penis in a Coati, which had united with a certain amount of deformity.

Two cases of hæmorrhagic cystitis in Ocelots, without obvious lesions to account for the presence of blood.

Enlarged prostate was found once in a Dog. An abscess of the right ovary in a Coati burst and gave rise to fatal peritonitis.

By far the most interesting case of all was that of a female Tiger aged twelve years, born in confinement.

Fig. 3.

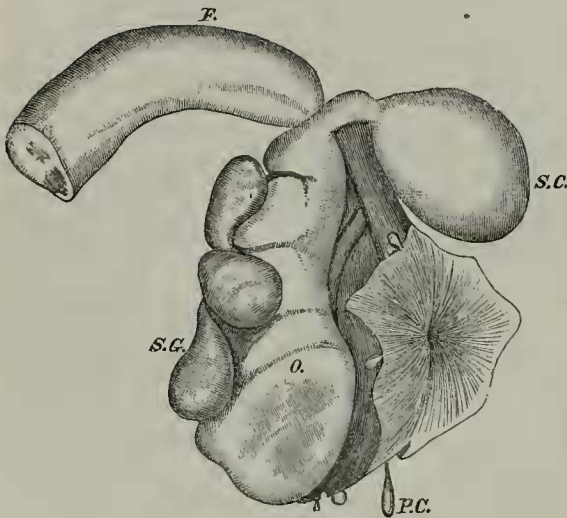


Fig. 4.

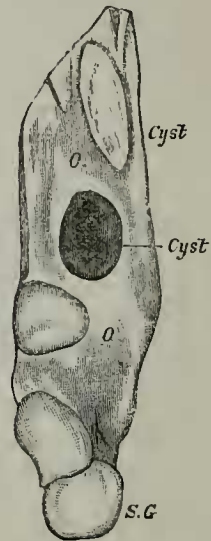


Fig. 3. Ovary and Fallopian tube of an old Tiger. O. Ovary transformed into cysts. S.G. Solid growths, which are really hypertrophied corpora lutea. P.C. Pedunculated cysts. S.C. Serous cysts originating in the organ of Rosenmüller.

Fig. 4. Transverse section of the other ovary, showing the cysts in the interior of the organ. S.G. The hypertrophied corpora lutea in transverse section.

The creature succumbed to a smart attack of pneumonia. On examining the ovaries, both presented abnormal conditions. The right ovary contained three solid tumours, about the size of a nut, and of a reddish colour, one of them being pedunculated. Two cysts of the size of a cherry occupied the substance of the organ (see fig. 3).

The left ovary presented three of these reddish solid cysts, two being of firmer consistence than the rest and pedunculated.

A cyst of the size of a gooseberry occupied the substance of the

ovary. Hanging from the fold of peritoneum between the ovary and Fallopian tube (meso-salpinx) is a cyst of the size of a cherry attached by a narrow peduncle, whilst scattered among the fringes of the open end of the Fallopian tube, are numerous pedunculated cysts the size of millet-seeds. These are shown in the annexed drawing (figs. 3, 4, p. 184). The solid cysts, when examined microscopically, proved to be hypertrophied corpora lutea. This case is of extreme interest on account of the relation it bears to similar growths in human subjects. Among the numerous growths originating in the immediate neighbourhood of the ovary in the human female, many of which attain gigantic proportions, two very distinct forms may be readily separated:—

1. Cysts peculiar to the ovary and originating in Graafian follicles.
2. Cysts of the broad ligaments, which, if they attain to any size, may secondarily involve the ovary in the course of their growth.

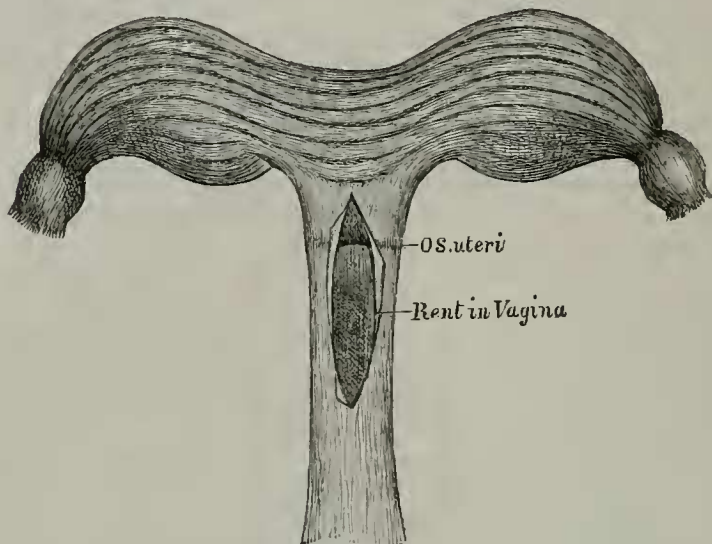
Careful observation has led to the view that cysts starting in the broad ligaments arise in connexion with the “organ of Rosenmüller.” This structure and its connecting ducts, lying in the meso-salpinx, is in itself of very great interest, inasmuch as it represents, with the duct of Gaertner, all that remains in the adult female of the Wolffian duct and segmental tubes so largely developed in early embryonic life. In the adult female these must be regarded as functionless organs.

Pathologists have long been aware that functionless structures and remnants of organs are exceedingly liable to take on diseased action; hence it is now the accepted view that the cysts so often found in the broad ligament are to be regarded as abnormal dilatations of these pre-existing ducts, remnants of the segmental tubes and ducts of the Wolffian body; therefore it is extremely interesting to find in the ovary of this Tiger the disease in its incipient condition. The interest, however, does not end here, for although I have searched far and wide, this is the first case of its kind which has come to hand. At the outset I mentioned that this particular animal was born in confinement, and must to a certain extent be regarded as a domestic animal. Dogs are occasionally the subject of well-developed ovarian disease; so it is very singular that a disease so prevalent in the human female, met with in the common bitch, and seemingly exceedingly rare in wild animals, should turn up in a Tiger which was born in confinement and passed a long life in the captive state.

A curious case of difficult parturition was seen in a Jackal. One morning I found the creature on the Prosector's table with a distended belly; on cutting into this, two young ones were found loose in the peritoneal cavity, whilst a third was jammed, head downwards, into the pelvis, and there tightly fixed. Examination proved that labour had commenced, but from some cause or other the vagina and neck of the uterus had split on the posterior aspect, and the young had been expelled from the uterus into the peritoneal cavity. The cause of the difficulty may have been the smallness of the pelvic outlet, but I think the foetuses must have been of unusual size. The

rent in the parts is shown in the drawing (fig. 5). It is a well-known fact that when a small bitch tries to accommodate a large Dog, the female often loses her life by rupture of the vagina, and consequent peritonitis. Escaping this, still she may pay the penalty of her lack of prudence, for the young will be unduly large, and delivery by *viæ naturales* an impossibility.

Fig. 5.



The uterus of a Jackal, seen from behind. The rent at the junction of the vagina and cervix uteri was made during parturition, the young escaping into the peritoneal cavity.

Tuberculosis.

To superficial observation, it would seem that half the animals dying in the Society's Gardens succumb to this affection. It so frequently happens that if the lung presents a spotted appearance, or on section shows caseous spots of any description, the condition is set down as "tuberculosis." After very careful inquiry the conclusion has been forced upon me, that "tubercle" is by no means so common among animals as is generally supposed. In a previous paper, it was shown that Monkeys are rarely attacked by tubercle, and subsequent observations tend to confirm this statement in every particular.

Three diseases are especially liable to be confounded with the one now under consideration. The precision afforded by the microscopical examination of diseased tissues has led to a more rigid definition, and consequent restriction, of the term tubercle from such appearances as the lungs present in lobular pneumonia, or lung-tissue consolidated by pneumonia which, instead of resolving, ends in supuration, and lastly, encysted parasites.

If these three morbid conditions be excluded, then *tuberculosis* is

very uncommon. The larger Carnivora (Lions, Tigers, and Leopards) are exceedingly vulnerable to attacks of pneumonia, and Bears frequently die from this affection, due to the suppuration of the consolidated portion of the lung. The Coati (*Nasua*) is very liable to suffer from cavities in its lungs due to this breaking-down of inflammatory products, and on three occasions pneumothorax has resulted from the rupture of a vomica. Once I met with a Liou with such a condition of things, and, in addition, by some means the air had made its way into the cellular tissue at the root of the neck, so that the creature was "blown up" like a calf in a butcher's shop.

With ordinary care there need be little fear that parasites may be mistaken for tubercle, but this does happen occasionally. By far the most important cases of tuberculosis remain to be described.

For a considerable time I have been investigating tuberculosis in birds, in which the disease is exceedingly common. After a considerable number of observations I came to the conclusion that the disease had its origin in the food or at least in the alimentary canal. From the splendid series of researches which enabled Koch to announce to the world his discovery of the "bacillus of tuberculosis," it would seem that the specific nature of this disease depends on the presence of this minute rod-like organism. On submitting the viscera of the diseased birds to Dr. Heneage Gibbes, who is an authority in this particular department of pathology, he found bacilli by "thousands and tens of thousands."

In December last we communicated these facts to the Pathological Society, and at the same time adduced the following facts as evidence that this disease of Fowls is in all probability infectious. I was aware that certain of the Carnivorous animals, of which the viscera had been examined, presented similar lesions to those observed in the diseased Fowls. Two cases soon came to hand, one a Paradoxure, the other a *Felis eyra*. These animals are fed on birds' heads and viscera, and as their livers contained "bacilli" it was fair to infer that they had accidentally contracted the disease by feeding on tuberculous birds.

What the precise nature and origin of these organisms may eventually turn out to be, is of course very uncertain; the matter is still being investigated and must for the present remain *sub judice*.

The facts recorded in the preceding pages are the outcome of the post-mortem examination of a considerable number of the Carnivora. From January 1882 to February 1884 one hundred and thirty of these animals died, varying in size from a Lion to a *Cynictis*. Of this number I have had the opportunity of examining the viscera of nearly all, excepting now and then, when an animal of great rarity was required for dissection, and its anatomical value far surpassed its interest from a pathological standpoint.

It behoves me in conclusion to offer my very best thanks to the Society for the liberal use of so much valuable pathological material.